USB-1024LS

24-bit Digital I/O

Low-speed USB 2.0 device

User's Guide

MEASUREMENT COMPUTING™

USB-1024LS

USB-based Digital I/O Module

User's Guide

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About this User's Guide

What you will learn from this user's guide

This user's guide explains how to install, configure, and use the USB-1024LS so that you get the most out of its USB digital I/O features.

This user's guide also refers you to related documents available on our web site, and to technical support resources.

Conventions in this user's guide

For more information on …

Text presented in a box signifies additional information and helpful hints related to the subject matter you are reading.

Caution! Shaded caution statements present information to help you avoid injuring yourself and others, damaging your hardware, or losing your data.

<#:#> Angle brackets that enclose numbers separated by a colon signify a range of numbers, such as those assigned to registers, bit settings, etc.

bold text **Bold** text is used for the names of objects on the screen, such as buttons, text boxes, and check boxes. For example:
1. Insert the disk or CD and click the **OK** button.

italic text *Italic* text is used for the names of manuals and help topic titles, and to emphasize a word or phrase. For example:
The *Insta*Cal® installation procedure is explained in the *Quick Start Guide*.
Never touch the exposed pins or circuit connections on the board.

Where to find more information

Additional information about E-1608 hardware is available on our website at www.mccdaq.com. You can also contact Measurement Computing Corporation by phone, fax, or email with specific questions.

- Knowledgebase: kb.mccdaq.com
- Tech support form: www.mccdaq.com/support/support_form.aspx
- Email: techsupport@mccdaq.com
- Phone: 508-946-5100 and follow the instructions for reaching Tech Support

Introducing the USB-1024LS

This user's guide contains all of the information you need to connect the USB-1024LS measurement and automation device to your computer and to other data acquisition hardware.

The USB-DIO24/37 is a USB 1.1 low-speed module supported under popular Microsoft® Windows® operating systems. It is designed for USB 1.1 ports, and was tested for full compatibility with both USB 1.1 and USB 2.0 ports.

The USB-1024LS features 24 bits of digital I/O and one 32-bit external event counter. The device is powered by the +5 volt USB supply. No external power is required.

An on-board industry standard 82C55 programmable peripheral interface chip provides the 24 discrete digital I/O lines in four ports. You can configure each digital port independently for either input or output.

The USB-1024LS USB device is shown in Figure 1-1. All I/O connections are made to the screw terminals located along each side of the USB-1024LS.

Figure 1-1. USB-1024LS

USB-1024LS block diagram

USB-1024LS functions are illustrated in the block diagram shown here.

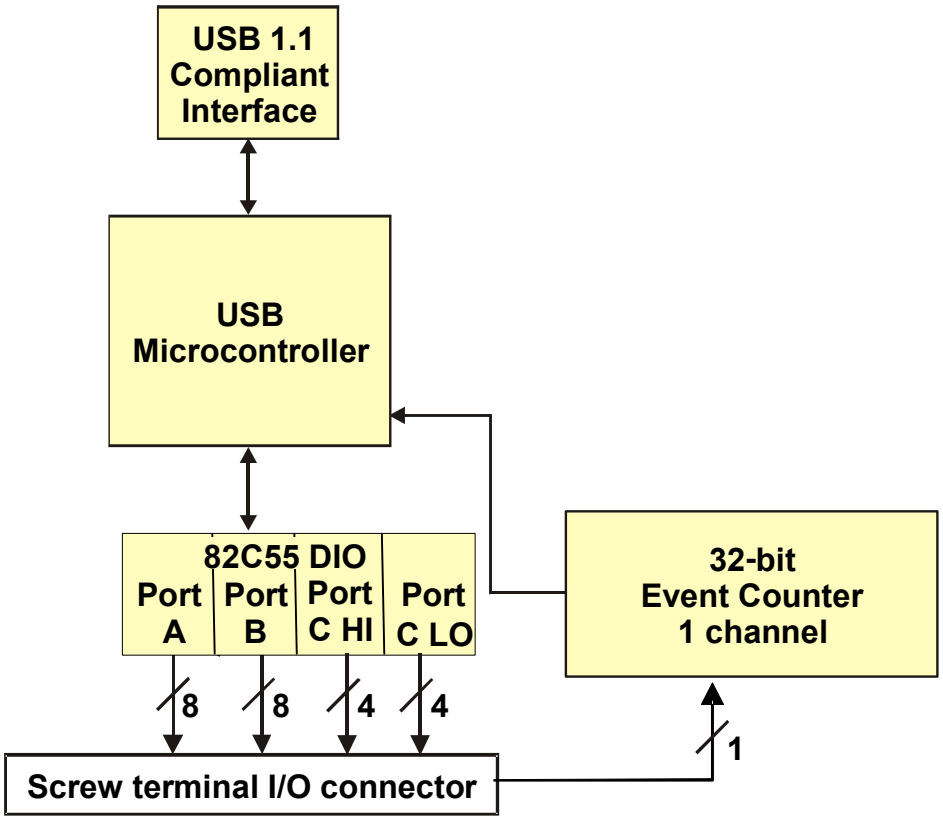


Figure 1-2. USB-1024LS functional block diagram

Software features

For information on the features of *Insta*Cal and the other software included with your USB-1024LS, refer to the *Quick Start Guide* that shipped with your device. The *Quick Start Guide* is also available in PDF at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf.

Check www.mccdaq.com/download.htm for the latest software version or versions of the software supported under less commonly used operating systems.

Connecting a USB-1024LS to your computer is easy

Installing a data acquisition device has never been easier.

- The USB-1024LS relies upon the Microsoft Human Interface Device (HID) class drivers. The HID class drivers ship with every copy of Windows that is designed to work with USB ports. We use the Microsoft HID because it is a standard, and its performance delivers full control and maximizes data transfer rates for your USB-1024LS. No third-party device driver is required.
- The USB-1024LS is plug-and-play. There are no jumpers to position, DIP switches to set, or interrupts to configure.
- You can connect the USB-1024LS before or after you install the software, and without powering down your computer first. When you connect an HID to your system, your computer automatically detects it and configures the necessary software. You can connect and power multiple HID peripherals to your system using a USB hub.
- You can connect your system to various devices using a standard four-wire cable. The USB connector replaces the serial and parallel port connectors with one standardized plug and port combination.
- You do not need a separate power supply module. The USB automatically delivers the electrical power required by each peripheral connected to your system.
- Data can flow two ways between a computer and peripheral over USB connections.

Installing the USB-1024LS

What comes with your USB-1024LS shipment?

The following items are shipped with the USB-1024LS:

Hardware

- USB-1024LS

- USB cable (2 meter length)

Additional documentation

In addition to this hardware user's guide, you should also receive the *Quick Start Guide* (available in PDF at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf). This booklet supplies a brief description of the software you received with your USB-1024LS and information regarding installation of that software. Please read this booklet completely before installing any software or hardware.

Unpacking the USB-1024LS

As with any electronic device, you should take care while handling to avoid damage from static electricity. Before removing the USB-1024LS from its packaging, ground yourself using a wrist strap or by simply touching the computer chassis or other grounded object to eliminate any stored static charge.

If your USB-1024LS is damaged, notify Measurement Computing Corporation immediately by phone, fax, or e-mail. For international customers, contact your local distributor where you purchased the USB-1024LS.

- Phone: 508-946-5100 and follow the instructions for reaching Tech Support.
- Fax: 508-946-9500 to the attention of Tech Support
- Email: techsupport@mccdaq.com

Installing the software

Refer to the *Quick Start Guide* for instructions on installing the software on the *Measurement Computing Data Acquisition Software CD*. This booklet is available in PDF at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf.

Installing the hardware

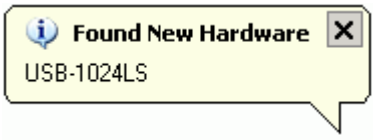
Be sure you are using the latest system software

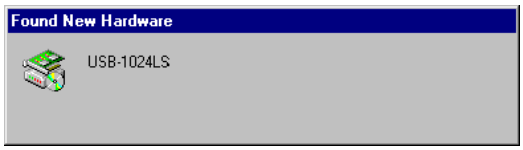
Before you connect the USB-1024LS, make sure that you are using the latest versions of the USB drivers.

Before installing the USB-1024LS, download and install the latest Microsoft Windows updates. In particular, when using Windows XP, make sure you have XP Hotfix KB822603 installed. This update is intended to address a serious error in Usbport.sys when you operate a USB device. You can run Windows Update or download the update from www.microsoft.com/downloads/details.aspx?familyid=733dd867-56a0-4956-b7fe-e85b688b7f86&displaylang=en. For more information, refer to the Microsoft Knowledge Base article "*Availability of the Windows XP SP1 USB 1.1 and 2.0 update.*" This article is available at support.microsoft.com/?kbid=822603.

To connect the USB-1024LS to your system, turn your computer on, and connect the USB cable to a USB port on your computer or to an external USB hub that is connected to your computer. The USB cable provides power and communication to the USB-1024LS.

When you connect the USB-1024LS for the first time, a **Found New Hardware** popup balloon (Windows XP) or dialog (other Windows version) displays as the USB-1024LS is detected by your computer.





Another **Found New Hardware** balloon or dialog opens after the first closes that identifies the USB-1024LS as a USB Human Interface Device. This balloon or dialog indicates that your USB-1024LS is installed and ready to use.

When the balloon or dialog closes, the LED on the USB-1024LS should flash and then remain lit. This indicates that communication is established between the USB-1024LS and your computer.

Caution! Do not disconnect **any** device from the USB bus while the computer is communicating with the USB-1024LS, or you may lose data and/or your ability to communicate with the USB-1024LS.

If the LED turns off

If the LED is illuminated but then turns off, the computer has lost communication with the USB-1024LS. To restore communication, disconnect the USB cable from the computer, and then reconnect it. This action should restore communication, at which time the LED will turn *on*.

Functional Details

External components

The USB-1024LS has the following external components, as shown in Figure 3-1.

- USB connector
- LED
- Screw terminal banks (2)

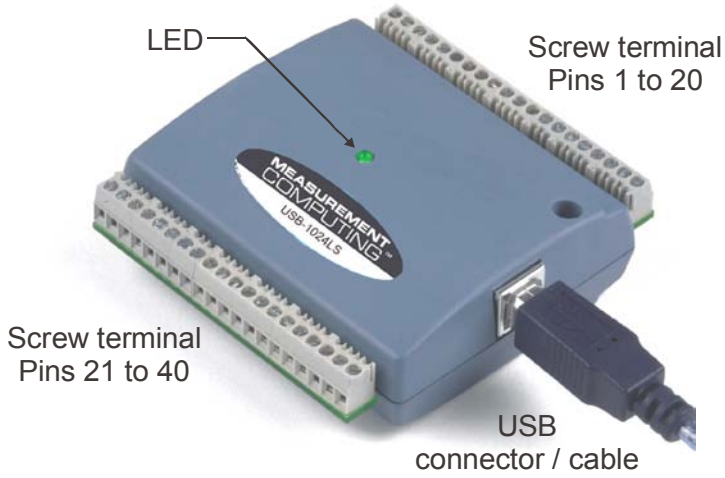


Figure 3-1. USB-1024LS external components

USB connector

The USB connector is on the right side of the USB-1024LS housing. This connector provides +5 V power and communication. The voltage supplied through the USB connector is system-dependent, and may be less than +5 V. No external power supply is required.

LED

The LED on the front of the housing indicates the communication status of the USB-1024LS. It uses up to 5 mA of current and cannot be disabled. Table 3-1 defines the function of the USB-1024LS LED.

Table 3-1. LED Illumination

LED Illumination	Indication
Steady green	The USB-1024LS is connected to a computer or external USB hub.
Blinks continuously	Data is being transferred.
Blinks three times	Initial communication is established between the USB-1024LS and the computer.

Screw terminal wiring

The USB-1024LS has two rows of screw terminals – one row on the top edge of the housing, and one row on the bottom edge. Each screw terminal bank provides 20 connections. Pin numbers are identified in Figure 3-2.

Figure 3-2. USB-1024LS screw terminal pin numbers

Screw terminal – pins 1-20

The screw terminals on the top edge of the USB-1024LS (pins 1 to 20) provide the following connections:

- Eight digital I/O connections (**Port C0 to Port C7**)
- One counter connection (**CTR**)
- Five ground connections (**GND**)

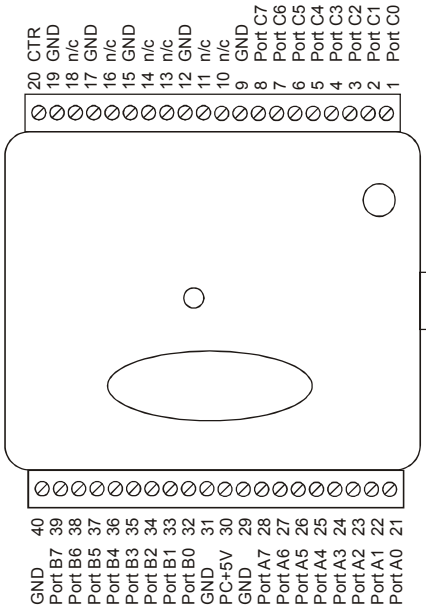
Screw terminal – pins 21-40

The screw terminals on the bottom edge of the USB-1024LS (pins 21 to 40) provide the following connections:

- 16 digital I/O connections (**Port A0** to **Port A7**, and **Port B0** to **Port B7**)
- One power connection (**PC+5 V**)
- Three ground connections (**GND**)

Main connector and pin out

Connector type	Screw Terminal
Wire gauge range	16 AWG to 30 AWG



Digital I/O terminals (Port A0 to A7, Port B0 to B7, Port C0 to C7)

Connect up to 24 digital I/O lines to the screw terminal containing pins 1 to 8 (**Port C0** to **Port C7**), pins 21 to 28 (**Port A0** to **Port A7**), and pins 32 to 39, (**Port B0** to **Port B7**). Refer to the pinout diagram on page 2 for the location of these pins. You can configure each digital port for either input or output.

When configured for input, you can use the USB-1024LS digital I/O terminals to detect the state of any TTL level input. Refer to the switch shown in Figure 3-3 and the schematic shown in Figure 3-4. If the switch is set to the +5 V input, Port A0 reads *TRUE* (1). If you move the switch to GND, Port A0 reads *FALSE*.

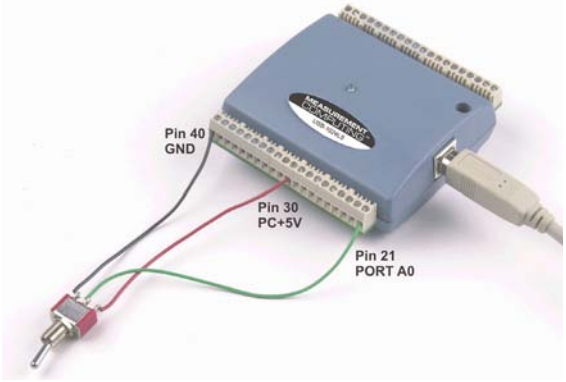


Figure 3-3. Digital connection of Port A0 detecting the state of a switch

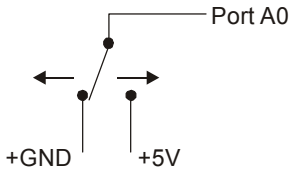


Figure 3-4. Schematic showing switch detection by digital channel Port A0

For more information on digital signal connections

For more information on digital signal connections and digital I/O techniques, refer to the *Guide to Signal Connections* (available on our web site at www.mccdaq.com/signals/signals.pdf).

Power terminals

The **PC +5 V** connection (pin 30) is on the bottom screw terminal of the USB-1024LS. Refer to the pinout diagram on page 3-2 for the location of this pin. This terminal draws power from the USB connector. The +5 V screw terminal is a +5 volt output that is supplied by the computer.

Caution! The +5 V terminal is an output. Do not connect to an external power supply or you may damage the USB-1024LS and possibly the computer.

The maximum total output current that can be drawn from all USB-1024LS connections (power and digital outputs) is 500 mA. This maximum applies to most personal computers and self-powered USB hubs. Bus-powered hubs and notebook computers may limit the maximum available output current to 100 mA.

Just connecting the USB-1024LS to your computer draws 18 mA of current from the USB +5 V supply. Once you start running applications with the USB-1024LS, each DIO bit can draw up to 2.5 mA. The maximum amount of +5V current available for external use, over and above that required by the USB-1024LS, is the difference between the *total current requirement* of the USB-1024LS (based on the application), and the *allowed current draw* of the PC platform (500 mA for desktop PCs and self-powered hubs, or 100 mA for bus-powered hubs and notebook computers).

With all outputs at their maximum output current, you can calculate the total current requirement of the USB-1024LS USB +5 V as follows:

(USB-1024LS @ 18 mA) + (24 DIO @ 2.5 mA ea) = 78 mA

For an application running on a PC or powered hub, this value yields a maximum user current of 500 mA−78 mA = 422 mA. This number is the total maximum available current at the PC+5V screw terminals. Measurement Computing highly recommends that you figure in a safety factor of 20% below this maximum current loading for your applications. A conservative, safe user maximum in this case would be 330 mA.

Since laptop computers typically allow up to 100 mA, the USB-1024LS in a fully-loaded configuration may be above that allowed by the computer. In this case, you must determine the per-pin loading in the application to ensure that the maximum loading criteria is met. The per-pin loading is calculated by simply dividing the +5 V by the load impedance of the pin in question.

Ground terminals

The 8 ground (**GND**) connections are identical, and provide a common ground for all USB-1024LS functions. Refer to the pinout diagram on page 3-2 for the location of the **GND** terminal pins.

Counter terminal

Pin 20 (**CTR**) is the input to the 32-bit external event counter. Refer to the pinout diagram on page 3-2 for the location of this pin. The internal counter increments when the TTL levels transition from low to high. The counter can count frequencies of up to 1 MHz.

Specifications

Typical for 25 °C unless otherwise specified.
Specifications in *italic text* are guaranteed by design.

Digital input / output

Table 1. Digital I/O specifications

Digital type	82C55
Number of I/O	24 (Port A0 through Port C7)
Configuration	2 banks of 8 and 2 banks of 4, or 3 banks of 8
Pull up/pull-down configuration	All pins pulled up to Vs via 47K resistors (default). Selection available for pull down to ground. Hardware selectable via zero ohm resistor.
Input high voltage	2.0 V min, 5.5 V absolute max
Input low voltage	0.8 V max, –0.5 V absolute min
Output high voltage (IOH = -2.5 mA)	3.0 V min
Output low voltage (IOH = -2.5 mA)	0.4 V max
Power up / reset state	Input mode

Counter

Table 2. Counter specifications

Counter type	Event counter
Number of channels	1
Input source	*CTR screw terminal*
Input type	TTL, rising edge triggered
Resolution	32 bits
Schmidt trigger hysteresis	*20 mV to 100 mV*
Input leakage current	*±1 µA*
Maximum input frequency	1 MHz
High pulse width	*500 ns min*
Low pulse width	*500 ns min*
Input low voltage	0 V min, 1.0 V max
Input high voltage	4.0 V min, 15.0 V max

Power

Table 3. Power specifications

Parameter	Conditions	Specification
Supply current (Note 1)		20 mA typ, 40 mA max
+5V USB power available (Note 2)	Connected to Self-Powered Hub	4.5 V min, 5.25 V max
	Connected to Bus-Powered Hub	4.1 V min, 5.25 V max
Output Current (Note 3)	Connected to Self-Powered Hub	460 mA max
	Connected to Bus-Powered Hub	60 mA max

Note 1: This is the total current requirement for the USB-1024LS which includes up to 5mA for the status LED.

Note 2: Self-powered refers to USB hubs and hosts with a power supply. Bus-powered refers to USB hubs and hosts without their own power supply.

Note 3: This refers to the total amount of current that can be sourced from the USB +5V and digital outputs.

General

Table 4. General specifications

Parameter	Conditions	Specification
USB controller clock error	*25 °C*	*±30 ppm max*
	0 to 70 °C	*±50 ppm max*
Device type		USB 1.1 low-speed
Device compatibility		USB 1.1, USB 2.0

Environmental

Table 5. Environmental specifications

Operating temperature range	-0 to 70 °C
Storage temperature range	-40 to 70 °C
Humidity	0 to 90% non-condensing

Mechanical

Table 6. Mechanical specifications

Dimensions	79 mm (L) x 82 mm (W) x 25 mm (H)
USB cable length	*3 meters max*
User connection length	*3 meters max*

Main connector and pin out

Table 7. Connector specifications

Connector type	Screw terminal
Wire gauge range	30-16 AWG

Table 8. Connector pin out

Pin	Signal Name	Pin	Signal Name
1	Port C0	21	Port A0
2	Port C1	22	Port A1
3	Port C2	23	Port A2
4	Port C3	24	Port A3
5	Port C4	25	Port A4
6	Port C5	26	Port A5
7	Port C6	27	Port A6
8	Port C7	28	Port A7
9	GND	29	GND
10	n/c	30	PC+5V
11	n/c	31	GND
12	GND	32	Port B0
13	n/c	33	Port B1
14	n/c	34	Port B2
15	GND	35	Port B3
16	n/c	36	Port B4
17	GND	37	Port B5
18	n/c	38	Port B6
19	GND	39	Port B7
20	CTR	40	GND

CE Declaration of Conformity

Manufacturer: Measurement Computing Corporation
Address: 10 Commerce Way
Suite 1008
Norton, MA 02766
USA

Measurement Computing Corporation declares under sole responsibility that the product

USB-1024LS

to which this declaration relates is in conformity with the relevant provisions of the following standards or other documents:

EU EMC Directive 89/336/EEC: Electromagnetic Compatibility, EN 61326 (1997) Amendment 1 (1998)

Emissions: Group 1, Class A

- EN 55011 (1990)/CISPR 11: Radiated and Conducted emissions.

Immunity: EN61326, Annex A

- IEC 1000-4-2 (1995): Electrostatic Discharge immunity, Criteria C.
- IEC 1000-4-3 (1995): Radiated Electromagnetic Field immunity Criteria A.
- IEC 1000-4-8 (1994): Power Frequency Magnetic Field immunity Criteria A.

Power line and I/O tests to IEC 1000-4-4, IEC 1000-4-5, IEC 1000-4-6, and IEC 1000-4-11 were not required. The device is DC powered from an I/O cable which is less than three meters long.

Declaration of Conformity based on tests conducted by Chomerics Test Services, Woburn, MA 01801, USA in June, 2004. Test records are outlined in Chomerics Test Report #EMI3902.04.

We hereby declare that the equipment specified conforms to the above Directives and Standards.

Carl Haapaoja, Director of Quality Assurance

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